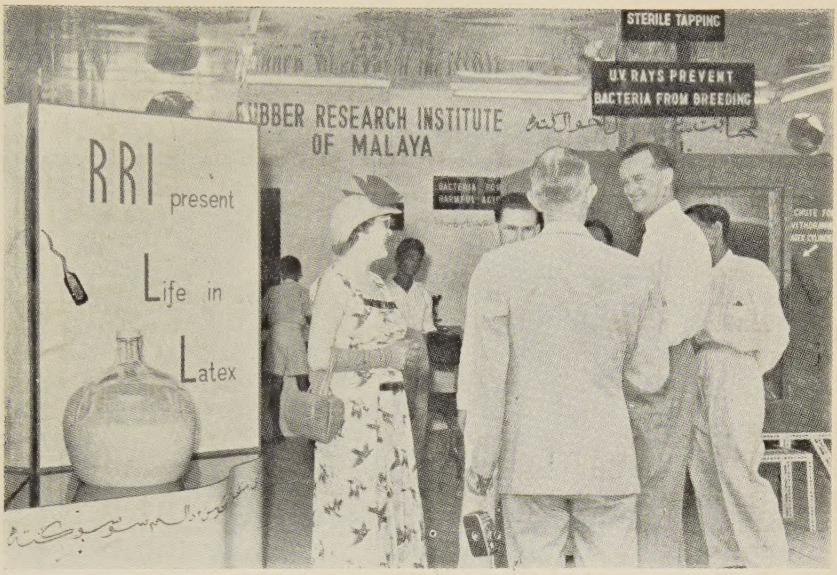
PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA



PLANTERS' BULLETIN TWENTYEIGHT

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Price
50 Cents

January
1957

The Uses and Control of Natural Undergrowth on Rubber Estates

R.R.I. Planting Manual No. 6

The second edition of this planting manual, edited by W.B. Haines, bears the publication date December 1940. Subsequent circumstances denied this useful book the wide distribution which it merits, and we now offer one copy gratis to any applicant in Malaya who is on the mailing list for *Planters' Bulletin*. The consideration of the best methods for the establishment, maintenance and control of indigenous cover plants remains sound; an appendix classifies cover plants practically, and contains about 80 full page drawings.

Stump Planting

Planters' Bulletin 6, which is no longer available, contained an article on this subject which remains up to date and is much in demand. We are pleased to draw attention to its reprinting in a recent issue of *The Planter*, for October 1956. The article covers nursery layout and manuring, cutting back and pulling, despatch and preplanting care, as well as planting, pruning and snagging.

OUR COVER SHOWS VISITORS TO THE R.R.I. STALL AT THE MALAYAN AGRI-HORTICULTURAL ASSOCIATION'S EXHIBITION LAST OCTOBER.

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OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur January 1957 Number 28

Editorial: High Yielding Material

Those who may be in some doubt about the future prospects for the natural rubber industry in Malaya can find encouragement in the pages of the *Rubber Statistics Handbook, 1955* compiled by the Department of Statistics, Federation of Malaya – with a proviso that full use be made of the best planting material. The Chief Statistician and his staff are to be complimented, especially on their careful analysis of yield data which they present with admirable clarity. We propose to examine the performance of high yielding material below.

This is the second issue of the *Rubber Statistics Handbook* to appear in its revised and improved form. A new feature is a section on rubber dealers, which is to be expanded considerably in the next issue. Much extra information is now included in the section on labour force, and some graphs give a fresh prespective to exports.

Malaya (Federation and Singapore) has a total of 3,500,000 acres planted with rubber, of which 2,025,000 acres are on estates of 100 acres or more. During 1955 some 1,610,00 acres of estate rubber in regular tapping produced 353,000 tons of rubber, giving an average yield of 490 pounds per tapped acre over the whole country.

The Chief Statistician has recorded separately the yields obtained from known high yielding material and known unselected seedlings. A preface defines high yielding material: 'All clonal seedlings and clones (budgrafts) approved by the Rubber Industry Replanting Board'. During the year 1,012,000 acres of known unselected seedlings on estates produced 160,000 tons of rubber, or 355 pounds per acre tapped. By comparison 446,000 acres of known high yielding material produced likewise 160,000 tons, but yielded 806 pounds per acre tapped.

The significance of these figures lies in the fact that they are based on countrywide production; the urgent need to replace old unselected seedling trees is again made clear. But there is yet more to be learned from the yield data for high yielding material.

The definition of this material embraces a wide range of clones and clonal seedling families, from the earliest selected material planted some twentyfive years ago to the highest yielding material selected and proved more recently. If at first sight an average yield of about 800 pounds per acre appears to fall short of the level forecast by the enthusiastic plant breeder, the wide range of potential performance within the high yielding class should be borne in mind.

The Chief Statistican has further analysed the data from the 446,000 acres of known high yielding material in bearing. His analysis shows that in the lower bracket – areas yielding below 800 lb/acre – 207,000 acres produced 60,000 tons, or 650 lb/acre; in the upper bracket – over

800 lb/acre – 239,000 acres produced 100,000 tons of rubber at a mean level of 940 lb/acre. No doubt many factors affect yield performance in practice, but it seems a fair assumption that the first bracket includes many of the older areas planted with clones and clonal seedlings which have been superseded.

We may therefore attribute the principal data as follows:

Unselected seedlings	355 lb/acre/yr
Older high yielding material	650 lb/acre/yr
Newer high yielding material	940 lb/acre/yr

These figures, based on recorded performance over the whole country, speak for themselves.

What are the prospects of further improvement? The plant breeder answers confidently that there is ample scope for the breeding and selection of still better material, but in order to obtain full advantage from its use changes may be needed in current planting and production practices. Further reference to data from modern high yielding material illustrates this point. In large scale field trials on the R.R.I. Experiment Station we have obtained mean annual yields of 1,500 to 2,100 pounds per acre from selected clones over ten years' continuous tapping on a standard half circumference alternate day system. On a number of similar large scale trials on estates under good management in different parts of Malaya the same clones have yielded from 1,200 to 1,600 pounds per acre per year. Turning again to the *Rubber Statistics Handbook, 1955* we find that in normal commercial plantings the highest yielding areas – 57,000 acres on 200 estates which produced 29,000 tons – had an average yield of just over 1,100 pounds per acre. Some of the difference in recorded production from similar material under different circumstances may well be due to the closer supervision of tapping in experimental areas, and to the method of yield recording by cup coagulation, which may reduce losses of latex which are difficult to prevent in estate practice.

Speculation on the changes in treatment necessary to obtain the maximum return from modern planting material may range over a wide field, from the initial planting, through cultivation and manuring from planting to maturity, to tapping methods and organisation of tapping routine. All of these aspects are subjects of constant investigation, and the range of yields from the same material illustrated by the figures quoted above suggest that modern high yielding areas are capable of higher production in practice.

We do not propose now to embark on a discussion of task size and yield per tapper, except to reason that the organisation of tapping which gives the best return from unselected seedling rubber yielding 400 pounds per acre will not be appropriate for modern material capable of yielding at least 1,200 pounds per acre. On an estate with both kinds in regular tapping the problem is to ensure that tappers on standard sized tasks bring in two to three times as much crop from the high yielding stand as from the unselected seedlings. This should be the general rule if mature areas of good quality in both categories are being tapped on the same estate. Not to achieve it is to fail to use to best advantage the work of plant breeders over thirty years.

Tapping Before Replanting

The following notes recapitulate in summary our recommendations for tapping rubber prior to replanting, although we refer the planter to the articles appearing in *Planters' Bulletin 15, 19, 22* and *25* for the background needed to form a balanced opinion.

A. *Fields to be cut out in one year* — Two half circumference cuts in virgin bark and one or, better, two such cuts in renewed bark. Tap all cuts the same day, 200% intensity. To maintain this when three cuts are made, tap third daily; with four cuts tap fourth daily. Tap the two cuts in virgin bark upward when possible; otherwise continue an original ladder tapped cut down, and tap the new cut upward. Apply yield stimulant to a 3 inch strip of scraped bark, below downward and above upward cuts, in virgin bark only.

B. *Fields with 2 years' life* — Open a V/2 cut in virgin bark 25 inches above junction with renewed bark, and one cut in renewed bark at least 4 feet below high cut, on opposite side of tree. Tap both cuts downward, 200% intensity (alternate daily). Apply yield stimulant half yearly to a 3 inch strip below high cut only. Continue for one year then change to system A, above.

C. *Fields with 3 years' life* — As for system B, but continuing the first year's procedure for two years. The upper cut should be as high as possible (90-100 inches from ground).

D. *Fields with 3 to 6 year's life* — We suggest 200% double cut tapping throughout, possibly with yield stimulant applied half yearly at the high cut, provided the cuts are at least 4 feet apart.

We know of estates where trees are tapped third daily on both cuts (133%) when replanting is more than three years ahead, with half yearly stimulation at the high cuts. This appears a sound policy, provided the stimulant is applied to a two inch strip only, so as to avoid leaving treated bark untapped three months later.

New advice — Further to the article in *Planters' Bulletin 15,* we now advise scraping in the morning and painting in the afternoon, to avoid mixing of stimulant with latex. If rain or labour troubles interfere, apply stimulant the day after scraping.

Coal Tar Fungicides

Four papers have been collected together under the title 'Coal Tar Fungicides for the Control of Mouldy Rot' and issued as Communication 299 of the *Journal of the Rubber Research Institute of Malaya.* An official scheme for approving proprietary fungicides has been in operation since 1931. Testing methods used in our Pathological Division are described by Mr. F.W. Hutchison in the first paper. The fungicidal properties of isolated fractions of crude tar oil preparations were studied at the University of Bristol through the cooperation of the Agricultural Research Council of Great Britain, and this work is described in the remaining papers by Dr J.T. Martin, Mr G.V. Coles and Dr R.J.W. Byrde.

Now that the requirements of a good mouldy rot fungicide are known, manufacturers can improve their products. Eventually it should be possible to dispense with field tests of efficacy, relying instead on chemical analyses and a specification.

Safeguarding Crepe Rubber Machinery

We have pleasure in presenting a guest article by the Deputy Chief Inspector of Machinery, of the Federation of Malaya.

MOST INDUSTRIAL ACCIDENTS are attributable, not to failures of machines, but to human frailty. This does not mean that it is unnecessary to provide a mechanically safe environment. It does mean that human conduct — and it cannot be assumed that everyone will always be careful — must be taken into consideration when deciding whether a machine is dangerous or not. Human conduct is variable. The most elaborate and efficient safety devices cannot prevent a person bent on self destruction from so doing. The human behaviour which we have to take into account is such behaviour as is reasonably foreseeable, which is not necessarily the same as reasonable behaviour.

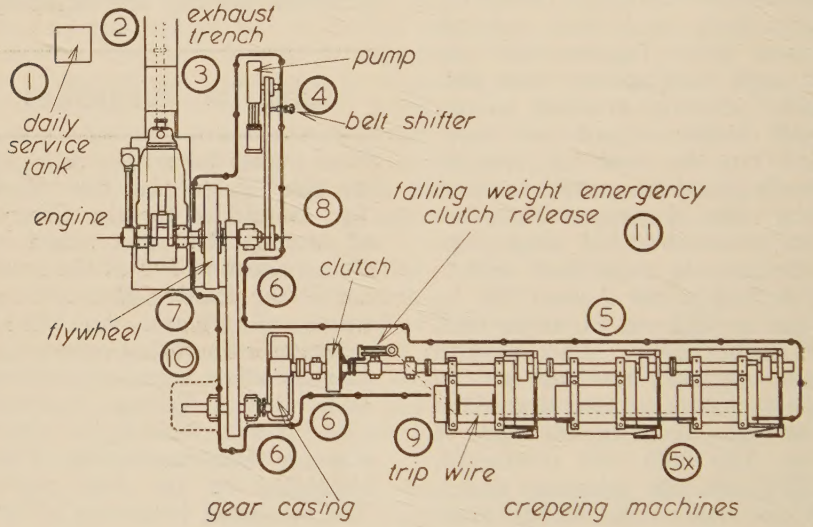


Figure 1. *Creping battery layout. Safety requirements:*

1 *Daily service tank well clear of exhaust.*
2 *Engine exhaust outside building.*
3 *Exhaust trench covered with steel plate or concrete slabs.*
4 *Belt shifter operated outside handrail, with locking device.*
5 *Handrail 3 feet 6 inches high with intermediate rail, and sufficiently close to moving parts to prevent access between.*
5x *Handrail without intermediate rail.*
6 *Lubrication points accessible from outside handrail.*
7 *Secure handhold for oiler, in way of flywheel.*
8 *Handrail not more than 10 inches from belt edge.*
9 *Trip wire in easy reach of operator.*
10 *Shaft projection protected by handrail or otherwise.*
11 *Falling weight sufficiently heavy to prevent re-insertion of clutch when resting on operating lever. Clutch re-set from outside handrail.*

In applying this principle to crepe rubber machinery, we must consider not only the individual machines but their arrangement as well. The essential machinery in a factory producing crepe rubber consists of a battery of horizontal two roll milling machines driven by a diesel engine through a common backshaft, clutch and flat belting. *Figure 1* shows the usual layout, and the requirements for safety. It will be observed that all moving parts are enclosed within a rail fence, except for those within the engine bedplate and the rollers of the milling machines. It will be noted also that the fence is close to the moving part it is designed to protect; otherwise access is possible between it and the moving part, and sooner or later someone will enter the enclosure and be injured. This is an example of unreasonable behaviour that is reasonably foreseeable. All operations such as oiling, resetting the clutch tripping device, or operating belt shifters, should be arranged so that they can be performed from a position of safety outside the fence. Never should any person need to enter, or indeed be permitted to enter, the fenced enclosure while the machinery is running.

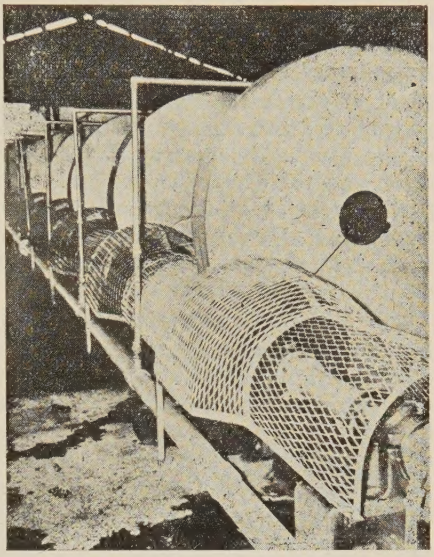


Figure 2. Backshaft protected by expanded metal guards.

Fences, if they are to provide adequate protection, should be at least 3 ft 6 inches high with one intermediate rail, and a toe board should also be provided in way of the flywheel pit. Steel pipe rails and stanchions, of outside diameter not less than $1\frac{1}{4}$ inches, are the best and most durable form of construction. There are, of course, other methods of providing protection. Belt, drives, clutches and shafting may be completely enclosed in sheet or expanded metal guards. *Figure 2* shows an excellent example of the guarding of a backshaft and individual machine clutches, using expanded metal.

On every battery, means must be provided to allow the operator to stop the machines in an emergency. This almost invariably takes the form of a tripwire running along the front of the battery connected to the clutch release mechanism. It is important that the tripwire be located within easy reach of the operator. A good position is four feet above floor level, and vertically over the line of contact of the rollers. The wire should be arranged to run as straight as possible; where changes of direction are necessary the wire should pass over pulleys. The fixed end of the wire should be provided with means to take up any slack or stretch.

The horizontal two roll rubber milling machine is too familiar to need description. In common with all machines driven by toothed gearing, the gears must be guarded; this is best done by completely enclosing the gears in a sheet metal guard. Arrangements must be made for lubrication. With modern machines, where oil is the lubricant, the fitting of automatic lubricators or drip feed oilers is recommended. On the majority of the machines, however, grease is manually applied, and a portion of the gears has to be exposed to do this. Contrary to popular belief, it is not essential to apply the grease while the machinery is running. It may take a little longer when the machines are stopped, but it is infinitely safer. Attendants must be prevented from reaching the point of greatest danger — the mesh of the gears. Grease openings in guards, for that reason, should be placed over the outrunning surfaces of the gears. The direction of rotation of the gears in the front roller drive makes this position inconvenient; the grease openings must therefore be located as far as possible from the nip of these gears, and the size of the opening made sufficiently small to prevent the attendant's hand from reaching the gears. Grease should be applied by a brush or even a piece of wood—never by the fingers.

The feeding of material, coagulum, semi-processed rubber or scrap, into the rollers of the machine is an operation that requires the undivided attention of the machinist. It the past, there has been a considerable number of serious accidents that can be explained only by lack of attention on the part of the operator. In most cases the operator allowed his hand to rest on the moving ribbon of rubber and before he realised it his fingers were crushed in the nip of the rolls. In other cases, usually associated with the feeding of coagulum or lump scrap, or the insertion of the partially processed blanket, the operator pressed the material into the nip, and when the rollers bit, his fingers — unless he was very alert — passed in with the rubber. To prevent such accidents it is now mandatory to fit a feeding platform in front of crepe milling machines. The platform is required to extend horizontally at least 30 inches from the vertical plane passing through the line of contact of the rolls, and to be not less than 39 inches from floor level at the edge nearest the operator. Side plates to prevent the operator from feeding from the side are also required. *Figures 3* and *4* show excellent examples of these platform guards. The dimensions of

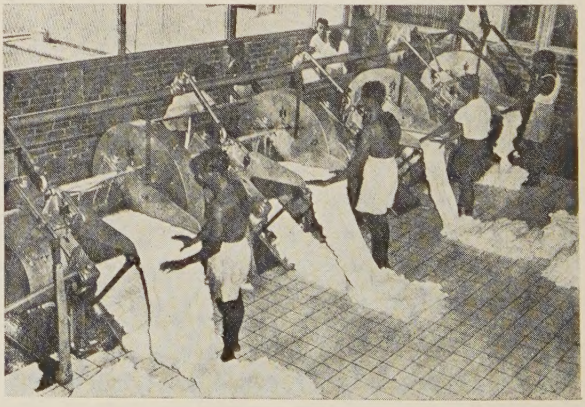


Figure 3. Normally arranged battery with feeding platforms.

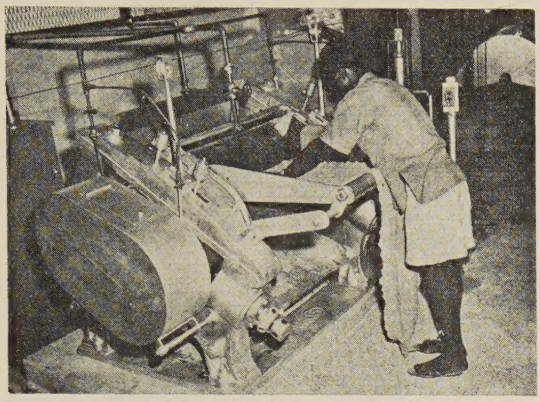


Figure 4. Modern creping machine with individual drive and reverse current braking.

the feeding platform are such that it is not physically impossible for the fingers of the operator to reach the nip of the rolls; it requires, however, a conscious effort to do so. That effort cannot be made unless the attention of the operator is directed to the making of it. Since the fitting of feeding platforms in 1954 the frequency and severity of accidents on crepe milling machines have fallen considerably. In 1955 there were only two reported accidents that involved permanent disability; both of them occurred on machines without a feeding platform.

Where hard coagulum or lump scrap is milled, operators are obliged to exert considerable pressure to force the lumps into the nip of the rolls. On numerous occasions the operator's hand has slipped from the rubber and entered the nip, always with serious results. To eliminate accidents of this type a mechanical feeding device, adapted from a design in use in Sumatra, was developed. The mechanical feeder is illustrated in *Figure 5*. The device is used on macerators in a number of remilling factories and is stated to increase the throughput of those machines. The use of the feeder is not mandatory on macerators in estate factories.

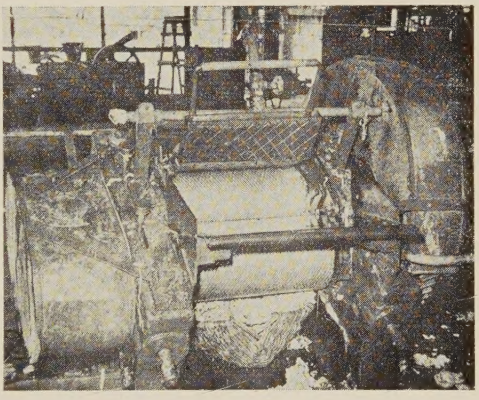


Figure 5. Type of mechanical feeder in re-milling factory.

LAMINATORS

In factories where sole crepe is produced laminators are used to build up the rubber to the required thickness. These machines are as dangerous as rubber milling machines, and have been the cause of many accidents. In common with all machines with an inherent nip hazard, means must be provided to prevent the operators' fingers reaching the line of contact of the rolls. One of the best methods is to fit a feeding table and to insert the rubber through a slot or tunel of such vertical

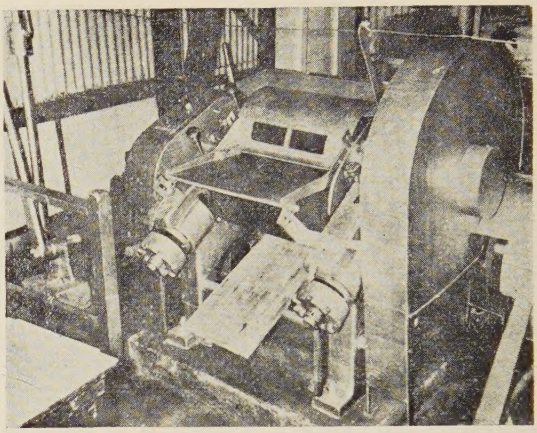


Figure 6. A well guarded laminator. Note perspex windows.

height as to permit the sheets to pass and to reject the fingers of the operator. *Figure 6* shows a well guarded laminator. Some laminators are arranged to be fed from both front and back. Protection must then be provided on both sides. As for the milling battery, operators must be provided with means of stopping the machine from the feeding position.

SCRAP WASHERS

Scrap washers are used in a comparatively small number of factories. The method of feeding, consisting as it does of merely emptying baskets of scrap into the trough, is simple and safe. The few accidents that have occurred on these machines have usually been associated with attempts to recover stones or other tramp material from the trough. These machines can be dangerous if any attempt is made to press the scrap rubber on to the serrated rollers. In most modern machines this is unnecessary as a flap over the trough prevents the rubber from being rejected. With older models it may be necessary to fit a grill over the trough to prevent the operator from reaching the rollers. The height of the lip of the loading trough should be not less than 3 ft 6 inches above the loading platform to prevent the possibility of anyone falling into the machine. Here again means must be provided for the operator to stop the machine in an emergency.

EMERGENCY STOPS

Mention has been made of the means to be provided to stop laminators, scrap washers and milling machines in an emergency. The law requires that these machines shall be capable of being stopped within a period of three seconds without any material between the rolls. Laminators and scrap washers usually present no problems in this connection. The higher inertia of the moving parts of the crepe milling machine makes stopping more difficult. At the speed at which these machines run, three seconds is equivalent to approximately one revolution of the back roller. This is not an arduous requirement. In the United Kingdom, it is the practice to require rolls to stop in one sixth of a revolution. In Malaya, with an engine driven battery fitted with solid bearings it is generally possible to stop the machines within the statutory period by disengaging the main clutch. Where an electric motor with reduction gearing is used, or where machines are fitted with

ball races, it may be necessary to incorporate a brake in the transmission system. A few new batteries are equipped with what is known as the 'reverse current plugging system' (as in *Figure 4*). Under this system the tripwire operates a switch which reverses the direction of current in the rotor and brings the motor and connected shafting to rest almost instantaneously.

Whichever method is adopted, whether reverse current plugging, clutch and brake, or clutch alone, it is essential that it fails to safety. That is to say, in the event of failure of the linkage, between the tripwire and whatever means are adopted to stop the machines, the machines cannot be operated. For that reason reliance cannot be placed on the action of a spring, which explains the almost universal use of the falling weight clutch release machaism.

Nowadays crepe milling machines and scrap washers are often installed with individual electric drives. It is essential under these circumstances that the effect of actuating the emergency tripwire is to stop all the machines, since it is seldom the operator who is in difficulties who succeeds in stopping the machines.

GENERAL SAFEGUARDS

Other factors besides the safeguarding of machinery have to be taken into account in establishing safe working conditions. Adequate illumination free from glare is essential. Level, even floors with non-slippery surfaces contribute to safety. Good ventilation helps to keep operators alert and therefore safe; any measure that reduces muscular fatigue acts in the same way. That accidents are costly, both in terms of cash and manpower, cannot be stressed too strongly. It is fitting, perhaps, to conclude with an extract from an address given by the President of the United States, which has as much cogency in relation to this country as to America: 'The plain fact is that our Nation cannot afford the needless loss of skilled workers if we are to produce for prosperity in this country and peace abroad.'

Permission to take photographs in the premises of the following firms is acknowledged: Messrs, The Gula Kalumpang Rubber Estate Ltd, Bukit Mertajam Rubber Company Ltd, Wilkinson Process Rubber Company Ltd, Ghee Seng Company, and Petaling Rubber Estates Ltd.

A. NEILSON

Clonal Trials

Our Botanical Division is preparing a full account of clone and clonal seedling trials which were established on estates from 1936 to 1938 in cooperation with the R.R.I. Briefly, records show mean yields of 1,400 to 1,600 lb/acre/year over 9 years of continuous tapping since 1946, for the best of RRIM '500' series clones. The best families of clonal seedlings yielded some 200 to 300 lb/acre less than the best clones under comparable conditions.

Planting Recommendations, 1957-8

PLANTING RECOMMENDATIONS for the next two years vary little from those previously published in *Planters' Bulletin 18* in May 1955. Prang Besar Isolated Garden Seedlings from plots F and G have been upgraded for large scale planting and on reappraisal clone RRIM 519 has been recommended for medium scale planting. Some changes have been made in material listed for experimental scale planting.

The primary characters on which we base our assessment of the value of any planting material are vigour of growth and high yielding capacity; vigour of growth is important in reducing to a minimum the non-productive period between planting and tapping; the importance of high yield potential needs no emphasis.

Further characters considered are:

i bark quality, texture, reaction to tapping, bark renewal;

ii resistance to storm damage and to disease;

iii quality of latex, colour, tendency to coagulate prematurely, chemical and physical characters that affect processing as sheet, crepe, or as concentrated latex;

iv general uniformity within a clone or seedling family.

These characters, sometimes called secondary characters, can be very important and marked inferiority in any one of them may lead to the rejection of a clone or seedling family, even though it may be satisfactory in all other respects.

All these factors require a considerable time to test and it is not until satisfactory proof of performance is available that a recommendation for large scale planting can be made. In such a recommendation no distinction is made between clones and clonal seedling families provided that they have received the necessary proof in experimental and commercial plantings under a range of conditions. All recommendations for planting on a large scale are made on the basis of recorded performance of the material in Malaya. Included in the recommendations for planting on a moderate scale or on an experimental scale are imported clones, not yet proven under Malayan conditions. For these our recommendations are based on information obtained from the countries of origin.

It should be realised that no clone is the best clone under all conditions nor is it the best clone for all purposes. The limitations of each type of clonal planting material are briefly indicated in the following sections under its particular name. Advice on the choice of clones therefore must also be considered in conjunction with their local performance.

For the newer clones for which only experimental scale planting is recommended, it is advised that the minimum size of plot on which such a clone is planted should be three tasks or twelve acres. It is now considered that adequate information on the performance of any clone or seedling family under local conditions cannot be obtained from a smaller plot unless in a statistically designed trial under strict recording conditions. Such trials are probably best left to be carried out by the Rubber Research Institute.

The recommended size for experimental scale plots on estates will mean some increase in the area allotted to such planting material. Any estates practising such a policy would probably not be the losers thereby, as the majority of the clones recommended for experimental scale planting are good yielders although the secondary characteristics of many remain to be proved. Local information on the behaviour of any particular clone or seedling family is worth far more than generalities on their performance throughout the country.

We strongly urge in this connection that estates should not purchase budwood of promising new clones merely to establish the material in a clone collection nursery against the time when it may be recommended for field planting. Such material if not established in the suggested area should at least be established in a permanent small scale planting with the smallest possible delay. Only in this way will some first hand evidence of the suitability of a clone for local use be obtained in advance of a firm recommendation to plant it on a larger scale. The permanent plot will provide an immediate source of branch budwood which can be readily checked and its identity confirmed. There will be no need to maintain an expensive multiplication nursery with the consequent risk of errors once the permanent plot has been budded.

Many clones no longer mentioned in these recommendations may still find favour with estates. We list for example clone Sabrang 24 on coastal estates which does not appear to do well on most inland estates. A clone on the recommended list may also be discarded under conditions where its defects become obvious. Clone Tjir 1 normally does well on poorer soils but is not suitable for exposed positions nor for high water table soils because of its heavy crown. Clones PR 107 and Gl 1 which are wind resistant give latices which are not satisfactory for concentration because (for different reasons) their mechanical stability is low. Clone RRIM 501 is susceptible to pink disease, and it may be advisable to avoid locations where the disease is endemic.

Clonal seedling families normally show a wide variation between the performance of the individual members of the family and thus with a judicious thinning programme their performance can be adjusted to the environment of the area in which they are to grow. They are more suitable for general use than buddings of one clone which may perform best only with a particular set of conditions. Success with clonal seedlings largely depends on the skill of the planter in thinning. It is worthwhile noting in this connection that good clones are not necessarily the parents of good seedling families and buddings of some of the known best parent clones would not now be used for planting. Any new clonal seedling family therefore must undergo the same rigorous period of test as a new clone before we can accept it as suitable for planting on a commercial scale.

With regard to stocks for budding, vigorous clonal seedlings are preferable to unselected seedlings. Experiments on stock scion relationships, although not particularly definitive, do suggest that illegitimate seedlings of clone AVROS 163 are excellent material for use as stocks, and failing these any vigorous seedling from a clonal planting selection should always be employed.

Our recommendations for planting material follow.

CLASS I — For planting on a large scale, up to eighty per cent of the area in aggregate.

Clones PB 86*, Tjir 1*, PR 107 (=LCB 510), RRIM 501*, RRIM 513*, and Gl 1*.

Clonal seedlings Prang Besar Isolation Garden Seed from plots D* & E*, F & G; Tjir 1 seed from monoclone plantings*, or from approved collection areas with other good parent clones*.

CLASS II — For planting on a moderate scale, up to twenty per cent of the area in aggregate.

Clones LCB 1320, GT 1, RRIM 519*, RRIM 526*; and Prang Besar Further Proof 5/51 and 5/63.

Clonal seedlings Chemara Isolation Garden Seed B and E; Prang Besar Further Proof A and further Proof B seed, Prang Besar Preliminary Proof Seed; seed collected from boundaries between plantings of clones known to be good seed parents such as Tjir 1, AVROS 157, BR 2, Pil B84, RRIM 501, PR 107, GT 1 and LCB 1320.

CLASS III — For planting on an experimental scale, in plots of three tasks or up to twelve acres.

Clones RRIM 600 to 616 and 620 to 630; Prang Besar T157, T207, T495, 9/82, 28/83, 28/59, 32/36, 12/127 and 5/76. Chemara 26, 30 and 32; Wardieburn A9; OY 1 and IRCI 7 from Indochina; and NAB 12, 15 and 20 from Ceylon.

Clonal seedlings illegitimate seedlings of high yielding clones not previously tested and collected from areas uncontaminated by seedlings or stock shoots.

The extent to which this broad classification is followed is, as stated above, largely determined by local knowledge which may sometimes justify the use of a clone or clonal seedling family on a larger scale than is generally recommended. With regard to clones for use on an experimental scale further information on the exchange clones which are not included in these recommendations will be published at a later date.

CLONES RECOMMENDED FOR LARGE SCALE PLANTING

PB 86 — A clone of moderate vigour with slow growth in the early years. On poor soils growth may prohibit use of this clone altogether. The crown is open and very wind resistant, with a yellowish foliage. In spite of its moderate vigour it is still the best all round Malayan clone. The white latex is of high mechanical stability, suitable for the manufacture of concentrated latex, pale crepe and smoked sheet. When

* *In tapping in our trials.*

growing reasonably well the bark characters and bark renewal are average to good. PB 86 yields more than clone Tjir 1 and has been found to be of good value in Ceylon, Indochina, and on certain estates in Indonesia.

Tjir 1 — A clone with heavy branches which make weak junctions with the main stem. Together with its dense heavy crown when young this makes it liable to wind breakage when planted in exposed situations, and to windfall on high water table soils. The character can be corrected to some extent by early pruning. This vigorous clone has reasonable yield and grows well on average to poor soils. The colour of the latex varies according to the site but is usually yellow, making it unsuitable for the manufacture of pale crepe without fractional coagulation or the use of a bleaching agent. Latex concentrate is stable. The bark characters are good and Tjir 1 is one of the best of the known seed parents. Though not of the highest yielding class it is still planted in Ceylon, Indochina, and some parts of Indonesia.

RRIM 501 — A high yielding clone showing outstanding vigour on coastal soils and on good inland soils. When properly tended it is probably one of the earliest maturing clones now planted on a large scale. It has a good habit and is not susceptible to wind damage nor to brown bast, but is susceptible to pink disease, which can be controlled economically. The clone is most susceptible to attack over the period from three to seven years from budding but as soon as the canopy closes the clone no longer requires treatment. The latex concentrate has an initial low mechanical stability but increases to a high value during the second and third months of storage. It produces a pale yellow soft crepe and a soft rubber. Virgin bark and first renewal bark are of average thickness. RRIM 501 appears to be a good seed parent.

RRIM 513 — A clone of the highest yielding class but of below average vigour; for this reason its use should be restricted to the best soils only. The crown is very heavy and trees may lean on poorly drained soils, but it is resistant to wind break. Virgin bark and first renewal bark are somewhat below average thickness. The clone does not appear to be susceptible to brown bast. The latex is white and mechanically stable and is very suitable for the manufacture of latex concentrate or pale crepe.

PR 107 — A vigorous clone of good yield with good secondary characters. The stem is straight and erect and the crown is well balanced and wind resistant. The latex is white and generally has a high dry rubber content; it has a low mechanical stability and is unsuitable for concentration by centrifuging. The clone is extensively employed in Indonesia and Indochina, but to a lesser extent than formerly.

Gl 1 — A moderately vigorous clone with an open, well balanced crown and dark green foliage. It grows well on most coastal soils and the better inland soils and is very wind resistant. It is entirely unsuited to 100 per cent intensity tapping systems particularly full spiral fourth daily, but is capable of excellent yields on a half circumference third daily system. The latex is mechanically unstable and unsuitable for concentration.

CLONES RECOMMENDED FOR MODERATE SCALE PLANTING

LCB 1320 — The highest yielder of all LCB clones and recommended for extensive planting in Java. The branching is late and it usually develops a lopsided crown susceptible to wind damage, unless corrective pruning is undertaken to promote branching when the trees are twelve to fifteen feet tall. For this latter reason it is not used on the east coast of Sumatra. A vigorous clone with thick bark, it is reported to have a white latex suitable for pale crepe manufacture and is also said to be reasonably suitable for concentration. The clone is not in tapping in Malaya.

GT 1 — A vigorous clone with a straight stem and compact crown of dark green leaves. It is stated to be one of the highest yielding clones in commercial plantings in Indonesia where it is recommended for large scale planting. It is said that the clone does not do well on poor soils. The virgin bark is thick and has good renewal. This clone does not develop male flowers on the majority of flowering shoots and hence is male sterile. For this and other reasons it is said to be a valuable seed parent.

RRIM 519 — A vigorous high yielding clone with a clumsy habit but good virgin bark and bark renewal. The clone is not susceptible to brown bast or to wind break, but may lean or fall on high water table soils. The latex is suitable for concentration but slightly yellow for the purpose of crepe manufacture. It has yielded more than RRIM 501 and RRIM 513 in one of our trials, and in general can be classed with these clones.

RRIM 526 — A vigorous high yielding clone with an attractive habit, resistant to wind break. The thicknesses of both virgin and renewed bark are good. The latex is suitable for the manufacture of crepe being only slightly yellow. Concentration may in certain sites present difficulty.

PB 5/51 — An attractive clone with usually a heavy crown and good branching habit. The latex is suitable for concentration but being deep yellow in colour is less suitable for making pale crepe.

PB 5/63 — A clone of average vigour with a straight erect stem and a compact crown.

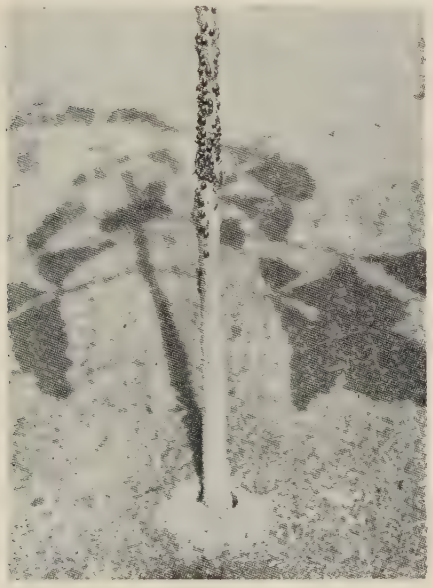
NEED FOR COMMERCIAL YIELD RECORDS

Our recommendations are based partly on results from our statistically designed experiments and partly on records from commercial plantings. A large proportion of the commercial records are from pre-war plantings which were brought into tapping after the occupation and thus do not give reliable comparisons of vigour between different types of material nor a true picture of the yields to be expected from them in the first years of tapping. We appeal, therefore, for the cooperation of planters and agency houses in sending us yield records from post-war areas of buddings and seedlings accompanied by information on date of planting or budding, density of planting, date of opening, standard of tappability and tapping system.

Scale Insects and Mealy Bugs

CERTAIN PLANT BUGS of the family Coccidae have been of considerable commercial value. The colouring matter cochineal was originally extracted from a mealy bug which lives on cacti. True shellac, now largely replaced by a synthetic substitute, is a resinous secretion of the lac insect, still cultivated in parts of India. The Coccids, however, are more important as pests of cultivated plants. The ease with which they can be transported over long distances with their hosts has led to their wide distribution. Strict phytosanitary legislation is enforced in many countries to limit their spread.

The sexes differ markedly. The male is a delicate winged insect, rarely seen because so minute. The fully grown female does not look like an insect, being highly specialised for a sedentary life more or less permanently attached to the host plant. The popular terms 'scale insect' and 'mealy bug' refer to the females, which are covered with a waxy, fibrous or resinous protective coat, or by a mealy secretion. They feed on plant juices, sucking them up through a hair-thin tube inserted deep in the tissues of the host.



Black scale — Seedling stem incrusted with Saissetia nigra; at its base a ring of soil excavated by ants attending the scale insects.

Black scale – Saissetia nigra female scales; one at the top attacked by a parasitic fungus. ($2\frac{1}{2}\times$ linear)

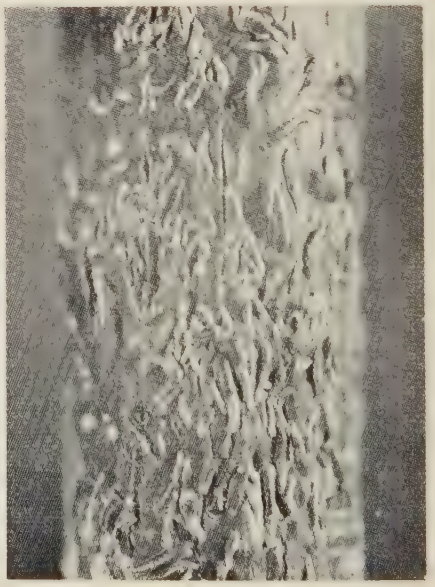
Rubber growing in Malaya is attacked by at least thirteen species of Coccids. Of these only three scale insects – *Saissetia nigra, Pulvinaria maxima, Lepidosaphes cocculi* — and a mealy bug — *Ferrisia virgata* — are common. *Saissetia nigra,* known as the black scale, and the mealy bug *Ferrisia virgata,* are most often seen.

SCALE INSECTS

Saissetia nigra has a worldwide distribution and is found on a great variety of plants. The appearance of the adult female as to size, shape and colour, depends on the host plant. On rubber it is three to five millimetres long, oval, and strongly convex. Its colour varies with age from light brown to black. Eggs are laid beneath the scale, the underbody of a female shinking as she lays her purplish pink eggs, until the cavity beneath the scale is filled with them. The winged male emerges from a thin transparent scale much smaller than the female scale and divided into nine plates in a characteristic pattern.

Pulvinaria maxima is easily distinguished by the large size of the adult female, which may be a centimetre in length, and by the white cottony ribbon at the hind end enveloping a mass of bright red eggs. The body is ash coloured. Unlike most scale insects, the adult *P. maxima* is able to crawl slowly from one part of the plant to another before settling down to lay her eggs. The male scales, of form similar to those of *S. nigra,* are often arranged along the margins of infested leaves.

Scale insect – Female Pulvinaria maxima scales closely clustered along a leaf petiole. (2 × linear)



Scale insect – Lepidosaphes cocculi scales on a small branch, almost covering the bark, which is corky where it should be green. (5 × linear)

The female *Lepidosaphes cocculi* is long and narrow, slightly curved, the scale widening gradually towards the hind end, brown in colour. The eggs are deposited beneath the parent scale. The male *L. cocculi* scale differs from the female only in being smaller.

MEALY BUG

The mealy bug *Ferrisia virgata* is widely distributed throughout the tropics and subtropics. A white mealy secretion, not a hard scale, covers its surface. The adult female attains a body length of about four millimetres. It has a slightly flattened cylindrical shape; the narrower, posterior, end bears a pair of tapering waxy tassels half as long again as the body. The pale yellow eggs hatch soon after they are laid.

Mealy bug — Leaves, petioles and stem of a seedling heavily attacked by Ferrisia virgata.

Mealy bug — Ferrisia virgata grouped on the underside of a leaflet. (3 × linear)

LIFE CYCLE

Coccids are mostly oviparous, the number of eggs laid by one female varying in different species from a few to several hundred. Though fertilisation is the rule, in some species males are either unknown or rare, with the result that successive generations of females are produced from unfertilised eggs. The egg masses are protected either by the parent scale or its dried body, or by a mealy covering. A few species are ovoviviparous, that is, the eggs hatch as they are being laid. The nymphs which emerge are known as 'crawlers'. They wander about on the plant before settling down in a suitable spot, which is generally on the soft, actively growing. top portion. After the first moult the sexes, which until then are indistinguishable, diverge in their development. Generally, the female undergoes one more moult before becoming adult; while in the male there are two more moults before the winged adult emerges. The female becomes greatly enlarged with the development of eggs within the body. The male soon perishes; it cannot feed— its mouthparts are undeveloped.

COCCIDS AND HEVEA

As pests of rubber, scale insects and mealy bugs cannot be considered important, though small numbers are commonly seen on a few scattered plants in most nurseries and in young plantations. Their increase in numbers is kept in check by many natural enemies. Occasionally they may get out of control by their enemies and increase rapidly to cause considerable local damage. In severe infestations a large part of the stem of a young plant may be covered by them, and they may become numerous on the undersides of the leaves. The bodies or waxy secretions of the adult females remain conspicuous long after the pests are dead; therefore an infestation should be judged by the amount of crawler activity. Heavily attacked plants are weakened by the loss of sap caused by the feeding of the large numbers of bugs; the leaves may turn yellow and fall. The growing point may die and be replaced by side shoots. Ultimately even the whole plant may die.

Though found also on the leaves and petioles, *Lepidosaphes cocculi* typically forms a heavy encrustation of the smaller branches, which develop a rough corky surface when they should be green. No difference in clonal susceptibility to attack by Coccids is known except that the few severe infestations of *L. cocculi* so far observed have all been on clone PB 86 two or three years from budding.

The continuous growth of young plants in the wet tropics allows also the continuous activity of the pests, and a succession of broods throughout the year; but their numbers go down during the rainy second half of the year, presumably because of fungal attack.

Scale insects and mealy bugs, like aphids, are constantly attended by ants of various species for the sake of the sugary liquid (honeydew) which they excrete. For many ants it is an important part of their food: some even shelter the bugs within their nests. The carton nest of the ant *Crematogaster rogenhoferi* has been found on young trees, built around a branch that is covered with the black scale. The same scale has been found on leaves composing the nest of the kerengga, *Oecophylla smaragdina*. Ants will carry crawlers from one plant to another, to establish a new colony for exploitation. The honeydew that the bugs produce, falling on to the leaves below, also gives rise to a black coating of sooty mould fungus growing on them. The fungus is not injurious as it does not penetrate the leaf surface, but it somewhat impairs the function of the leaf by shutting off some of the light.

CONTROL

Natural enemies of scale insects and mealy bugs are many and varied; principally they are predatory insects, parasitic insects, and parasitic fungi. To the first group belong the ladybird beetles, many species of which feed on Coccids both as larvae and as adults. Other predators are ant lion larvae, and the caterpillars of a small butterfly and of a moth. The last forms a covering for its body out of the scales that it has destroyed. Larvae of a midge are often seen in large numbers in the egg masses of *Pulvinaria maxima*, feeding on the eggs and on the crawlers as they hatch out. Parasitic wasp larvae feed internally within scale insects and mealy bugs, later pupating inside the host's body.

The minute round hole that is sometimes seen on empty scales is made when the wasp emerges. The dozen or so such parasites that we have obtained from Coccids on rubber certainly do not constitute a complete list. Parasitic fungi destroy many of these pests, particularly during the wet season.. The fungus which most commonly parasitises *Saissetia* and *Pulvinaria* finally envelops the scale in an orange to brown fungal cushion. The black scale is destroyed also by another fungus, which subsequently grows out as a white fringe.

Chemical control measures are rarely necessary owing to the activity of the predators and parasites. Mealy bugs have not been seen attacking more than a few plants, in any one place, but the scale insects, particularly the black scale, may increase rapidly and cause considerable damage before the natural enemies re-establish control. Under these circumstances control measurers are called for, but should be chosen not to be harmful to the natural enemies. A suitable spray is an oil emulsion, applied at weekly intervals until the attack is past. Spraying should be thorough and aim to wet every bug even in concealed places. A satisfactory spray can be made by emulsifying a pint of kerosene in a gallon of hot water in which a pound of soap has been dissolved. A garden syringe is useful in making the emulsion, which should be diluted with a further four gallons of water before spraying, making a final dilution of one part of oil in forty of water. Alternatively, the spray can be prepared from Albolineum:* the dilution recommended for this product is one part in fifty of water.

Although certain highly toxic insecticides that are now available bring about a drastic reduction in the numbers of scale insects and mealy bugs, their use is not advised because they kill the beneficial insects also. The oil emulsions, on the other hand, being harmless to other insects, do not interfere with natural control.

R. R. I. News

Fylomac 90 is one of the fungicides officially approved for the control of mouldy rot (*Planters' Bulletin 25*, page 69). More than once we have been told that Fylomac 90 initially gives good results but then fails to control the disease. In our experiments, conducted in the wet season, it has not failed but its use has resulted in a white bloom forming on the renewing bark, due to harmless fungi growing on the outer layer of dead cells. Doubt as to the efficacy of Fylomac 90 may therefore have arisen through mistaking the saprophytic fungal growth for mouldy rot. Any uncertainty can be resolved if bark shavings taken from the infected region, just above the cut, are sent to the Pathological Division for examination.

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Extra caution is needed when coastal clay areas are sprayed with sodium arsenite. Too frequent and too heavy spray aplications are the suspected cause of dieback and death of trees in such areas recently.

* *ready made concentrate obtainable from Messrs I.C.I. (Malaya).*

Drainage on Estates

TIDAL CONTROL GATES, BUNDS AND WATERWAYS have been discussed recently, in a guest article, 'Drainage of Low Coastal Areas' (*Planters' Bulletin 27,* page 101). We now consider other aspects of drainage in rubber growing areas, referring particularly to the effects of drainage on soils and plants, the criteria for judging the necessity and some practical details of siting drains inside the fields of rubber.

The natural drainage of a number of soil types in Malaya must be improved in order to obtain good growth of the rubber trees. Two sets of conditions may be operating: either the area has a naturally high water table, or excess surface water cannot penetrate into the soil reasonably quickly. Removal of water improves the oxygenation of the soil by allowing air to penetrate the interstices between the soil particles or aggregates. A soil may be characterised on the basis of its composition given as the percentage by volume occupied by solids, water, or gas, which will vary widely with different types of soil. For instance, the subsoil of a coastal clay may contain 40% by volume of solids, nearly 60% by volume of water and less than 1% by volume of gas. On the other hand a free draining sandy soil at a depth of 36 inches may contain 55% by volume of solids, 35% by volume of water and about 10% by volume of gas. If the percentage of gas in the soil is appreciable there are usually enough interconnecting voids to ensure that oxygen can diffuse from the outside air down deep into the soil.

How the roots of plants absorb nutrients is not fully understood, but the growth and development of a root system will evidently involve the use of some energy. A source of energy is the oxidation process in the root tissues which requires oxygen and releases carbon dioxide. Although some plants which normally grow in waterlogged conditions (such as rice) have hollows inside the stem, so that oxygen can diffuse from the air down to where it is needed, the roots of most plants must obtain their oxygen from the soil atmosphere.

The main object of artificial drainage on rubber estates is to maintain an adequate concentration of oxygen in the soil atmosphere and thereby allow the rubber trees to develop normally. But drainage is important for further reasons. The soil atmosphere contains other gases and water vapour. Excess carbon dioxide, which is both respired by the roots and produced by soil micro-organisms, must be able to diffuse readily away from the root zone, or it will restrict growth. In some inadequately drained coastal clay subsoils hydrogen sulphide may be a byproduct of anaerobic conditions, and if allowed to accumulate even in very low concentrations is toxic to most plant roots. By increasing the interconnecting voids in the soil, drainage can assist in the removal of this toxic gas. Excessive or harmful concentrations of salts in soil waters, as found in peat lands, can readily be removed under good drainage conditions and before harm occurs to the trees. Lack of drainage when trees are young causes shallow rooting and inadequate development of the tap root, with a danger of uprooting during a storm.

Surface water may not disappear quickly on some soils because either the soil pore space is too restricted or the subsoil is impermeable. The cutting of extra drains may then only partially improve soil conditions; a attempt to change the fundamental properties of the soil by a long term treatment with cover plants will be more appropriate.

When new land is being developed for rubber planting adequate drainage must be provided in the flatter areas where surface water will obviously accumulate. Where rubber trees have already been planted the need for additional drainage can be assessed in a number of ways. Often it will be found that trees growing near existing drains are better developed, and in such circumstances there can be little doubt that soil aeration at some distance from the drain is inadequate for optimum growth of the trees. Confirmation from girth measurements of suspected growth differences should be obtained if necessary.

Freshly prepared soil pits may be used for the same purpose. Soil examinations are of no value when made on the banks of an existing drain and a pit should be sited not too close to a drain but where conditions are representative of the rest of the field. The usual type is about six feet long and three feet wide. One end should be stepped down to the base of the pit at five feet depth, or to the watertable. The steps facilitate the close examination of soil and roots, for which a fairly large knife or a pointed stick is useful to pick away the face of the pit and expose a fresh surface of soil. The depth of penetration of the roots should be noted; this can only be judged with any accuracy where the rubber trees are mature. If root penetration is shallow – less than about 24 inches – then soil aeration is likely to be inadequate.

There will be cases where the girth or root range of the trees cannot be employed to evaluate the soil aeration status and use must be made of the appearance of the soil. Lack of aeration produces characteristic colour patterns in the soil and a knowledge of the significance of these patterns is of considerable value in deciding on the necessity for drainage.

If the investigator digs deeply enough in a coastal clay soil he will find a subsoil with a most characteristic bluish grey or greenish grey colour. Such soil has no free oxygen in it, usually smells slightly of hydrogen sulphide, and roots cannot grow there. If this bluish or greenish soil is nearer the surface than about three or four feet it is a definite indication of inadequate soil aeration.

Above the subsoil layer is usually to be found a layer of mottled soil in which aeration is inadequate. The mottles are rust coloured, of regular or irregular shape, and are usually from three quarters of an inch to a tenth of an inch across. In wet weather the watertable will be near the top of the mottled layer, in dry weather near the bottom. The extent of the mottled layer gives a rough indication of the range of fluctuation of the watertable; if mottling is within 9 inches of the surface, soil aeration can be considered insufficient for good growth of the trees.

Another indication of the soil aeration status is the depth of the watertable in the pit. This criterion should be interpreted with some caution for it will fluctuate according to the weather preceding the examination. As a rough guide to adequate soil aeration the watertable should be at least three to four feet below the surface, and drainage should normally produce, soon after fairly heavy rain, a watertable at this level.

No estate drainage system can work efficiently unless there is sufficient fall at the final outlet. This may require an expensive provision

of water gates or the cooperation of the owners of adjoining land.

Many experienced planters can, from a look at the condition of their trees, ascribe poor growth to 'wet feet'. Such diagnoses are of value but should always be checked by one or more of the methods described above before incurring expenditure on drainage.

The necessity for drainage of peat and flat low lying sandy areas can be judged in a similar manner, but for these the depth of the watertable is the easiest criterion of soil aeration. Peat lands present their own problems of drainage, especially when initially opened from jungle, which call for considerable practical experience for successful handling. Overdrainage, giving excessive drying out of the peat, must be avoided and in some districts of very variable rain fall drains may require temporary blocking to retain water against an expected dry spell. When the watertable in peat is lowered below the top of the clay subsoil special problems may arise from the release of substances which are toxic to plant growth. Chinese methods of cultivation of rubber on peat land sometimes allow for this eventuality by delaying the initial planting of rubber for a year or two, while a surface rooting catch crop is grown and the toxic conditions have time to disperse.

A few areas of inland soils are on appreciable slopes where soil aeration is inadequate because the subsoil is impermeable. Removal of standing surface water from such land may present difficulties because of the risk of soil erosion in the drains, which have to run down slopes. On these soils, which are fortunately not widely distributed, it is of great importance to establish a vigorous leguminous or indigenous bush cover with roots that can penentrate deep into the soil and thus improve its structure.

The spacing of drains will be decided by the nature of the soil and will most usually be left to the man on the spot, with his local knowledge and previous experience of the site. In a rather impermeable coastal clay more drains will be required than in a more permeable peat. 'Scupper' or aeration drains up to 18 inches depth serve a useful purpose in preventing water from lying on the surface after rain. Smaller drains of this nature are of particular value when they cut through the ridge of spoil from a larger drain, for such ridges often prevent surface water from reaching the larger drains.

In a normal well drained soil the main chemical reactions take place under oxidising conditions, but in underdrained soils reducing conditions predominate, giving different types of chemical end products, which are generally harmful to plants and soil micro-organisms. Drainage conditions and their effect on soil water and soil atmosphere relationships play a vital part in soil weathering and the formation of the ultimate soil type; adequate drainage is essential in heavy texture soils if a high level of soil fertility is to be maintained. In coastal clay soils proper aeration is usually the most important requisite for full development of the trees. Without it root depth is severely limited to a relatively small volume of soil from which the trees cannot absorb sufficient nutrients to grow really well. On such soils manuring will usually be of little value, and any permanent improvement of the conditions of the trees must come from improvement of soil drainage.

Inspection of Sources of Supply of Approved Clonal Seeds

Schemes for assistance in replanting rubber in accordance with notifications under the provisions of The Rubber Industry (Replanting) Fund Ordinance, 1952 (Federation of Malaya No. 8 of 1952) stipulate that replanting shall be with high yielding material. This is interpreted as follows:

> "high yielding rubber" means rubber trees grown from planting material which has been, or may from time to time be, recognised by the Rubber Research Institute of Malaya to be high yielding and which has been obtained from a source approved by the Board, or of which the Board may from time to time approve, after consultation with the said Rubber Research Institute

High yielding material may be either budgrafted trees or colonal seedlings. Provision of ample supplies of budwood of the best proved clones is straightforward. There are likewise adequate sources of supply of clonal seeds of satisfactory parentage but the sources of supply need to be checked and found acceptable in accordance with the definition quoted above.

A procedure for selection, inspection and approval of sources of supply of reliable clonal seeds is already in operation as follows:

i Owners of mature plantings of budgrafted rubber believed to be suitable as sources of supply submit to the R.R.I. essential particulars together with plans of the areas.

ii The R.R.I. sends an inspector, who is competent to identify budded trees of approved parent clones, to make a thorough examination and to mark all trees 'not true to label' in the area proposed for seed collection. Undesirable trees are clearly marked and the situation is reported to the owner.

iii The owner may agree to remove all marked trees, after which a second inspection is made by the R.R.I. in order to ensure that they have been removed or killed, and that the boundaries of an area within which all seeds collected can be regarded as being high yielding clonal seeds are clearly marked. The site is then recommended for approval as a source of clonal seeds.

It is emphasised that the source only is approved; it is not possible to guarantee material that may be supplied therefrom, for this will depend upon efficiency of collection and supervision, these being the responsibility of the supplier.

iv All operations should be completed before the flowering period during which the seeds to be collected are set.

Thus, if it is desired to supply approved clonal seeds in the main seeding season, September to October, then the collection area must be inspected and approved at least six months previously, i.e. before wintering and flowering.

We enclose notes on the selection of seed collection areas, together with a form of application for inspection. Additional copies may be obtained on request from the Rubber Research Institute.

The Standard Engravers & Art Printers, 63 Campbell Road, Kuala Lumpur, Selangor